

NASA VIIRS Atmosphere SIPS Update

MODIS/VIIRS Science Team Meeting

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Atmosphere SIPS Overview

- The VIIRS Atmosphere SIPS (ASIPS) is located within the Space Science and Engineering Center at the University of Wisconsin-Madison.
- ASIPS is responsible for supporting the development, testing, evaluation, and production of VIIRS atmosphere products created by the ROSES-funded VIIRS Science Team members (aka “Continuity products”).
- ASIPS supports global standard and near real time processing in “forward stream” mode and reprocessing of entire mission records.
- ASIPS delivers VIIRS atmosphere products to NASA LAADS for archive and distribution.
- ASIPS delivers imagery to NASA GIBS for display in Worldview.

LAADS (not ASIPS) is responsible for the production, archive, and distribution of MODIS atmosphere products (MxD35, MxD07, MxD06, MxD04, MxD08, ...) supported by NASA Senior Review.

Atmosphere SIPS Responsibilities: VIIRS/MODIS Products

Data Ingest

- Ingest and store SNPP, NOAA-20, and NOAA-21 Level 0 data (VIIRS, CrIS, ATMS)
- Ingest and store Aqua MODIS Level 1B and MODIS Level 2 Atmosphere
- Ingest and store all required ancillary data

Operational Processing

- Standard Products are created within 48 hours of observation.
- Near Real Time Products are created within 3 hours of observation.
- Reprocessing of mission record when new product version is approved by Science Team.

Product Delivery

- Level 2 and Level 3 standard products (VIIRS and MODIS) are delivered to LAADS in forward stream and when mission record is reprocessed.
- Near Real Time Products are hosted at ASIPS and accessed via LANCE.
- Level 2 Product imagery is delivered to GIBS for display in NASA Worldview.
- Copies of Level 2 and Level 3 products are stored at ASIPS.

Atmosphere SIPS Responsibilities: Science Team Support

- ASIPS provides a local test environment (sipssci2) for product generation software development and testing by ST members.
- ASIPS provides a local searchable archive of L1 and L2 products.
- When software is ready for more extensive testing by the ASIPS, a delivery system is used to ensure that every delivery is archived and tagged.
- Delivered/integrated product generation software can be run interactively.
- Each ST member has a dedicated ASIPS point of contact to support product generation software testing, integration into the processing system, and product delivery to LAADS, GIBS, and LANCE.
- ASIPS provides extensive tools and resources for product evaluation (e.g., local Worldview, sensor/satellite collocation, Matchmaker collocated products, ...).
- ASIPS provides GPU server (sipsgpu1) for testing of products using ML/AI algorithms.

Atmosphere Discipline Team Members (Product Creators)

Team Leads	ROSES-20 A.52 and A.33 Funded Proposals
Christina Hsu (NASA GSFC)	Extending Long-Term Aerosol Data Records from MODIS to VIIRS using e-Deep Blue Algorithm. (ROSES – 2020 A.52)
Robert Levy (NASA GSFC)	Upgrading the Dark Target aerosol data record for the 2020s and beyond. (ROSES – 2020 A.52)
Kerry Meyer (NASA GSFC)	The continuation and evolution of the CLDMSK and CLDPROP continuity cloud product suite. (ROSES – 2020 A.52)
Kerry Meyer (NASA GSFC)	Transitioning an existing near real-time MODIS cloud and above-cloud absorbing aerosol retrieval algorithm into a new MODIS/VIIRS continuity product. (ROSES – 2020 A.33)
Vincent Realmuto (NASA JPL)	TIR-Based Volcanic SO ₂ Science Products for MODIS and VIIRS. (ROSES – 2020 A.33)

Former Atmosphere Discipline Team Members

Team Leads	ROSES-2013 A.29 and ROSES-2017 A.37 Funded Proposals
Eva Borbas (UW – Madison), Bryan Baum (retired)	Fusion of VIIRS and CrIS Data to Construct Supplementary Infrared Band Radiances for VIIRS. (ROSES –2017 A.37)
Bo – Cai Gao (NRL)	Continuation of Standard Cirrus Reflectance Product from the EOS Terra and Aqua MODIS to Suomi NPP VIIRS. (ROSES – 2013 A.29)
Eva Borbas (UW – Madison)	Continuation of EOS Clear Sky Infrared Total Precipitable Water Vapor Product Using a Combination of VIIRS and CrIMSS Measurements. (ROSES – 2013 A.29)

NASA headquarters and ESDIS have indicated that ASIPS can continue to support orphaned products if the former Team member has other NASA funding.

Products Generated by the ASIPS (4/23)

Product Short Name	Product Description	ST Lead	Distribution
AERDB_L2_VIIRS_[SNPP NOAA20] AERDB_D3_VIIRS_[SNPP NOAA20] AERDB_M3_VIIRS_[SNPP NOAA20]	Deep Blue Aerosol (day only) Standard and NRT	Christina Hsu (NASA GSFC)	LAADS (standard) LANCE (NRT)
AERDT_L2_VIIRS_[SNPP NOAA20]	Dark Target Aerosol (day only) Standard and NRT	Robert Levy (NASA GSFC)	LAADS (standard) LANCE (NRT)
CLDMSK_L2_VIIRS_[SNPP NOAA20]	Continuity Cloud Mask (day/night) Standard and NRT	Bob Holz (SSEC UW)	LAADS (standard) LANCE (NRT)
CLDMSK_L2_MODIS_Aqua	Continuity Cloud Mask (day/night) Standard	Bob Holz (SSEC UW)	LAADS
CLDPROP_L2_VIIRS_[SNPP NOAA20] CLDPROP_D3_VIIRS_[SNPP NOAA20] CLDPROP_M3_VIIRS_[SNPP NOAA20]	Continuity Cloud Properties (day/night) Standard	Kerry Meyer (NASA GSFC)	LAADS
CLDPROP_L2_MODIS_Aqua CLDPROP_D3_MODIS_Aqua CLDPROP_M3_MODIS_Aqua	Continuity Cloud Properties (day/night) Standard	Kerry Meyer (NASA GSFC)	LAADS
SNDRSNCrISL1BIMG (SNPP) SNDRJ1CrISL1BIMG (NOAA-20)	Collocated VIIRS Level 1 and cloud mask statistical summary	Dave Tobin (SSEC UW)	GESDISC

ASIPS Level 3 Software (Yori)

Yori is a user-configurable software package that efficiently aggregates geophysical variables into a Level 3 netCDF4 product file.

Step 1:

- The user prepares filtered input data files (e.g., from Level 2 granules) and a Yori configuration file.
- The configuration file tells Yori how to grid the filtered input data

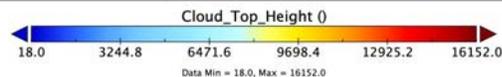
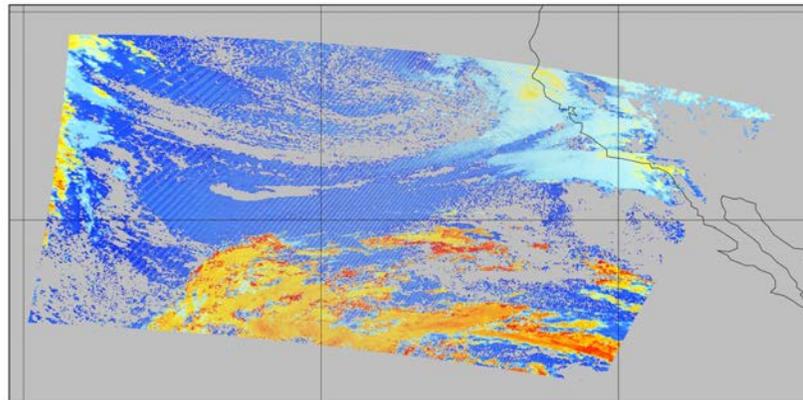
Step 2:

- `yori-grid` reads the filtered input data files and produces a gridded granule according to the instructions provided in the Yori configuration file

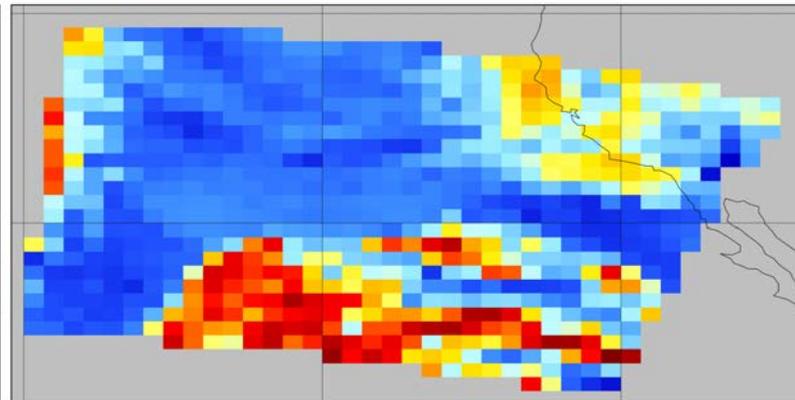
Step 3:

- `yori-aggr` aggregates multiple gridded granules (from *Step 2*) into Level-3 products

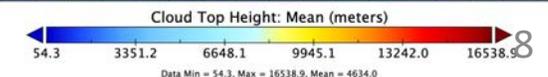
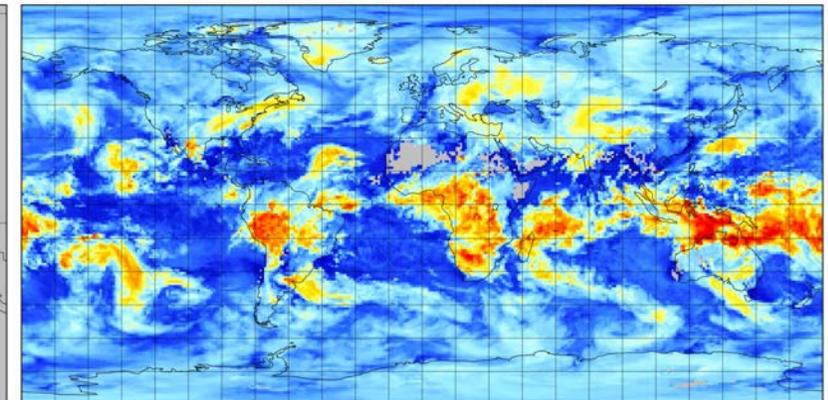
Cloud_Top_Height



Cloud Top Height: Mean



Cloud Top Height: Mean



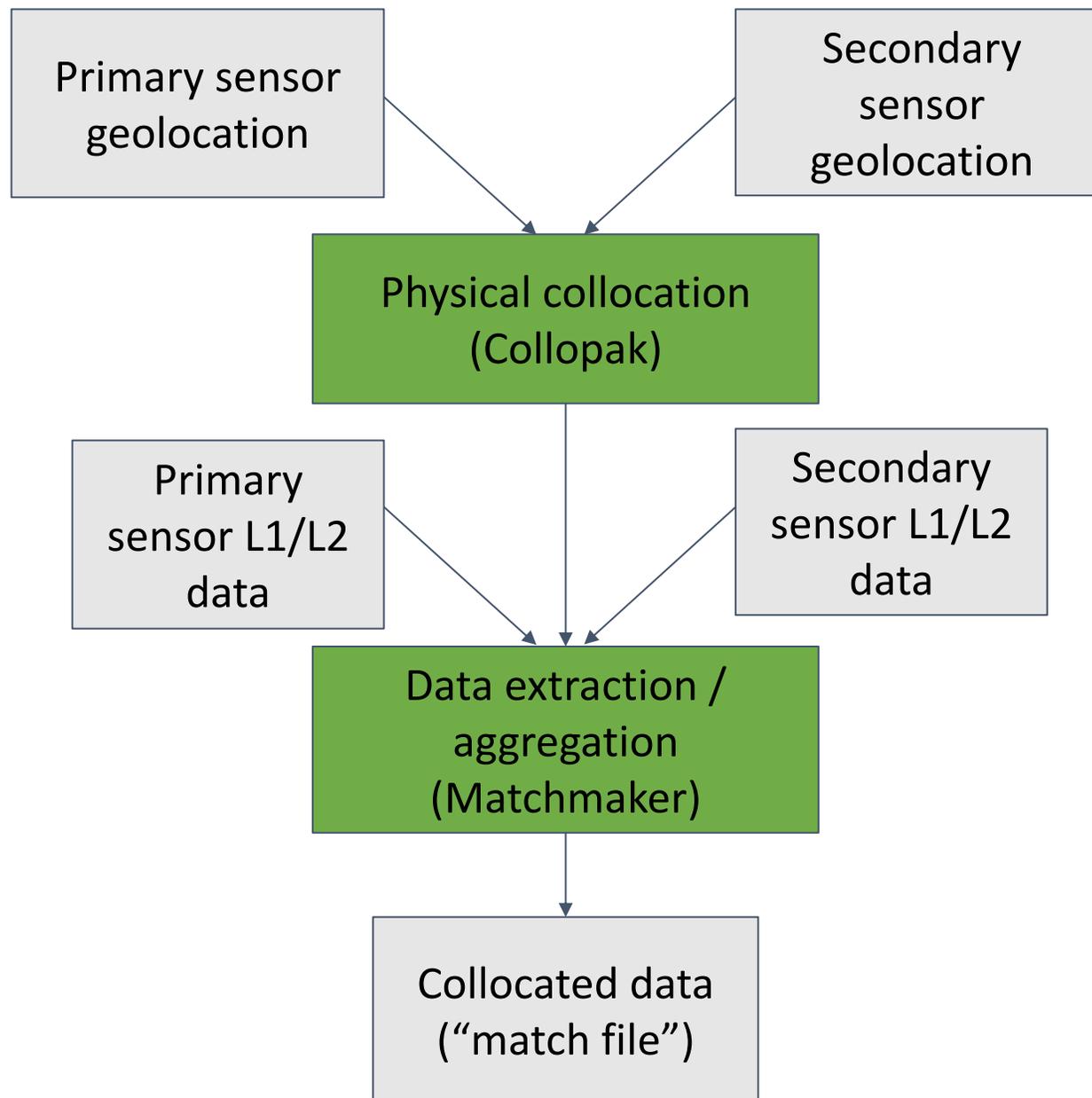
ASIPS Collocation Tools

SIPS multi-sensor collocation tools support:

- Calibration assessment of L1 data (e.g., MODIS-VIIRS reflectance biases)
- Validation of L2 products (e.g., CALIPSO for analysis of cloud & aerosol retrievals)
- Algorithm development using multiple instruments (e.g., Fusion, CrIS IMG)

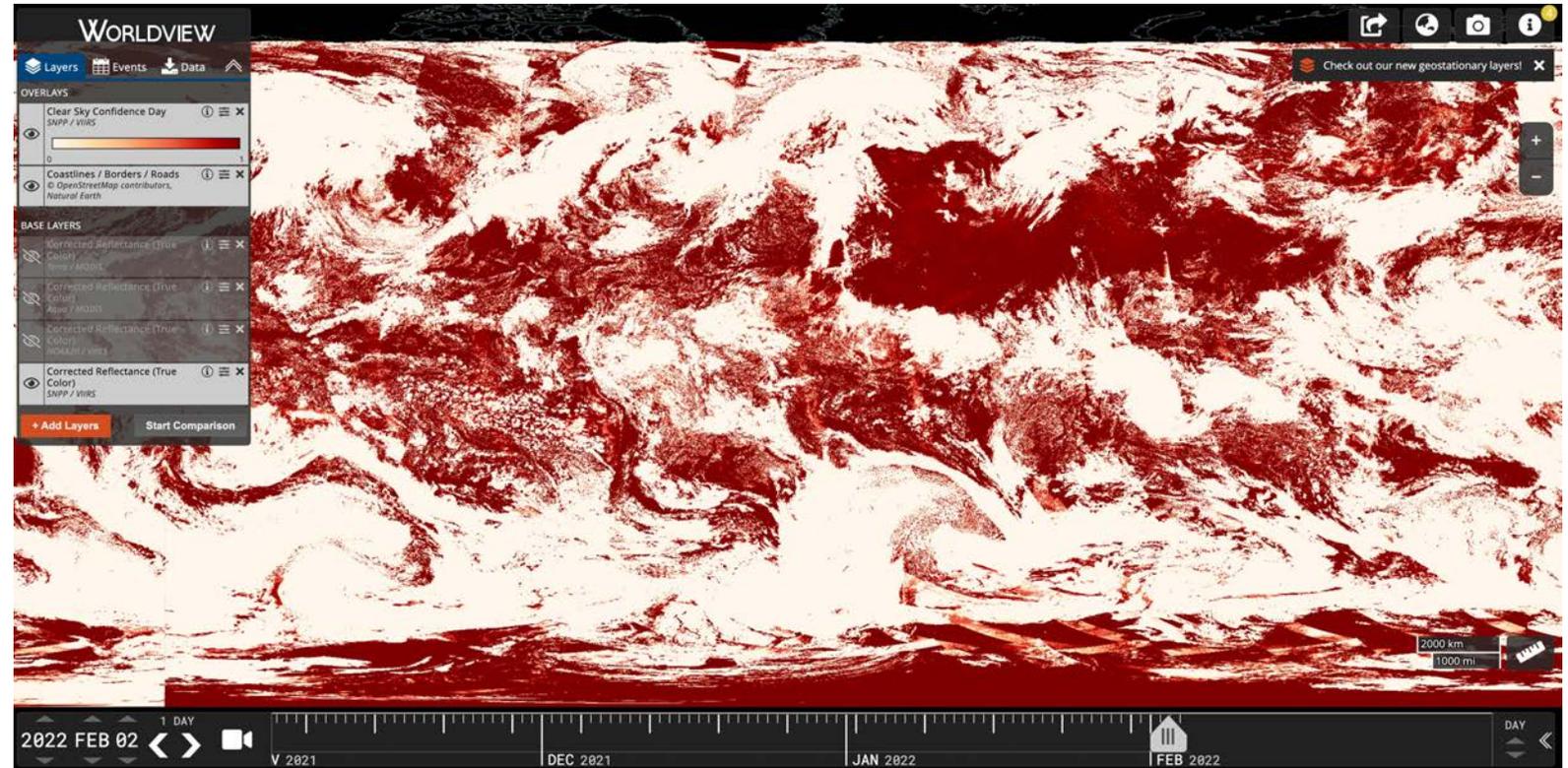
“Collopak” software performs geometric calculations to identify collocated observations

“Matchmaker” software aligns L1/L2 sensor data into a joint file for easy comparison or combined use



ASIPS Local Worldview

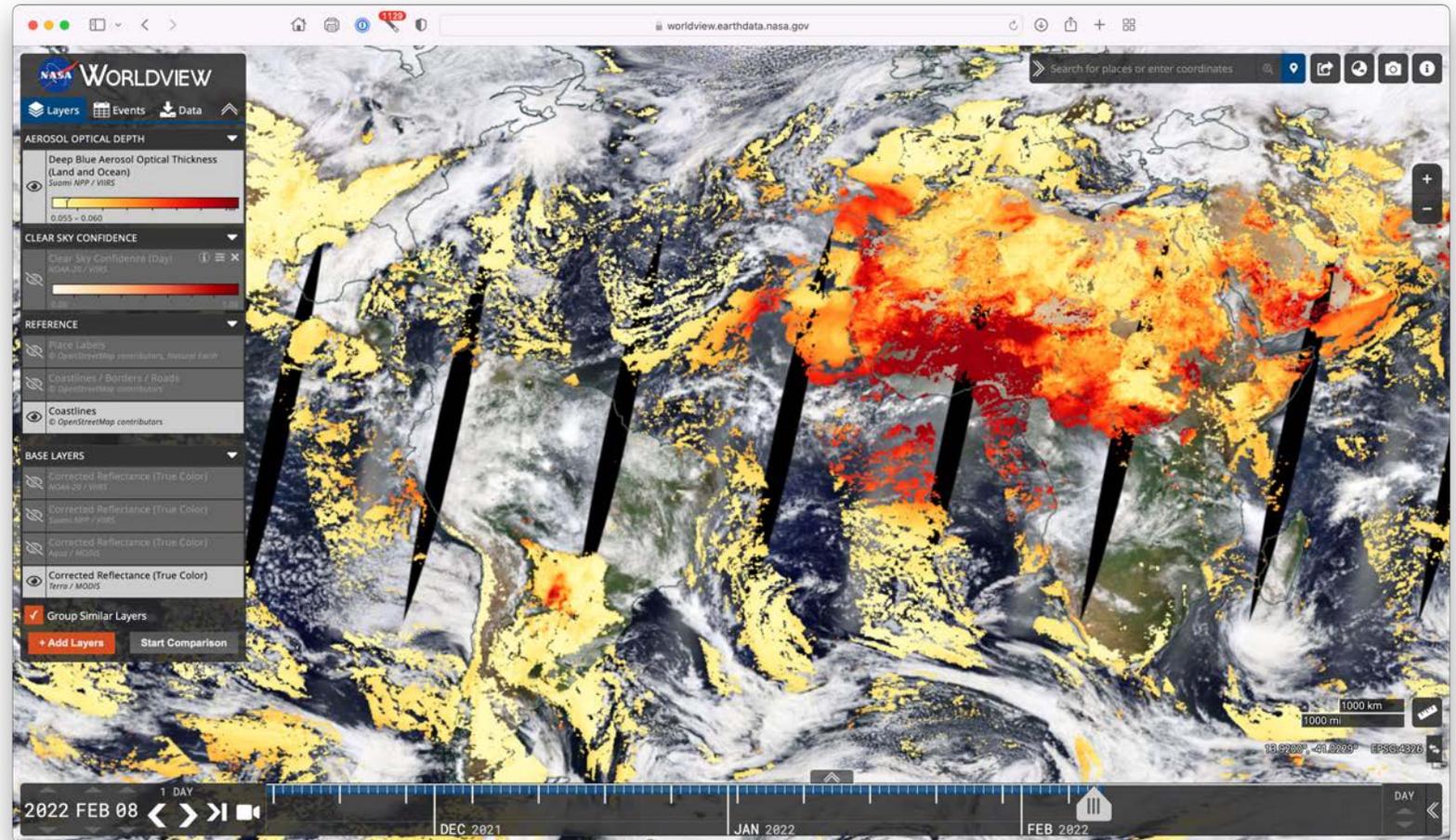
- L2 product imagery is generated by ASIPS and displayed in a local instance of Worldview.
- Able to display multiple days for test versions of L2 products.
- Can create unique colormaps with a specified min/max.
- Can create multiple layers for different bands.
- Fewer restrictions on the number of layers (compared to NASA Worldview).



<https://sips.ssec.wisc.edu/worldview/>

NASA Worldview

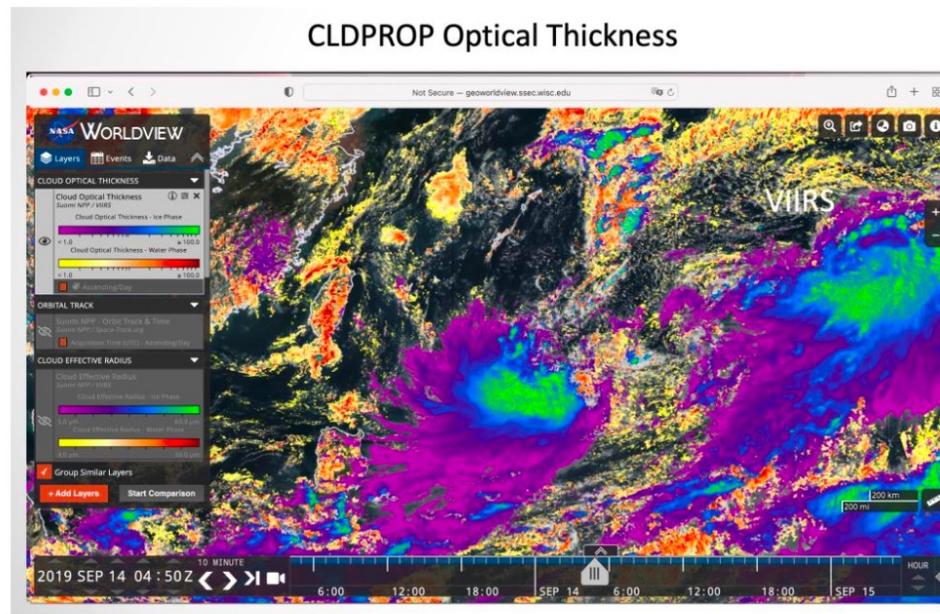
- L2 product imagery is created by ASIPS and delivered to NASA GIBS (the back end of Worldview).
- Recommended maximum of 4 layers per product (Day and night is two layers)
- ASIPS can reprocess and deliver a mission record to GIBS.
- However, this process can take several months due to resource limits at GIBS.



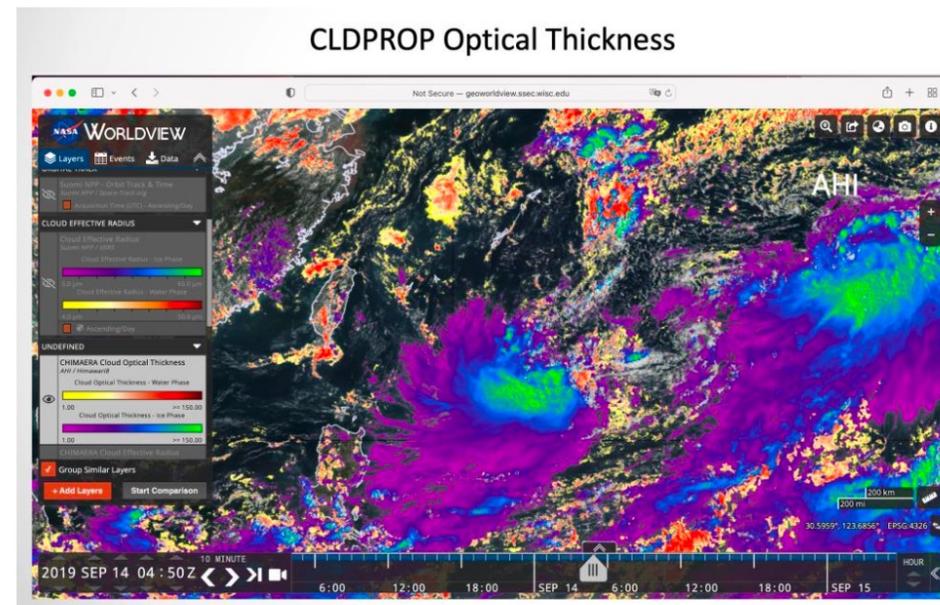
<https://worldview.earthdata.nasa.gov/>

GEO vs. LEO

- Atmosphere SIPS processed 4 months of G16, G17, and AHI cloud products using code delivered by VIIRS ST.
- Match files were generated for ABI/AHI with SNPP/NOAA-20 VIIRS, Aqua MODIS, and CALIPSO for both L1B and L2 products to validate and assess continuity with LEO products.
- Inter-calibration of AHI vs. VIIRS reflective solar bands was derived.



SNPP VIIRS



Himawari-8 AHI

Figure 1. Comparison of SNPP VIIRS (top) and Himawari-8 AHI (bottom) Cloud Property Optical Thickness products for 04:50 UTC on 12 September 14, 2019. (Holz, et al., 2022)

Level 3 Interactive Analysis

- A-SIPS developed interactive analysis workflows for the science teams.
- Software tools including Zarr, fsspec, xarray, and dask provide the means to access and analyze large remote datasets (e.g., L3 VIIRS cloud products) without needing to download entire files.
- Figure 1 shows interactive dashboard allowing comparison of L3 products over arbitrary time ranges.

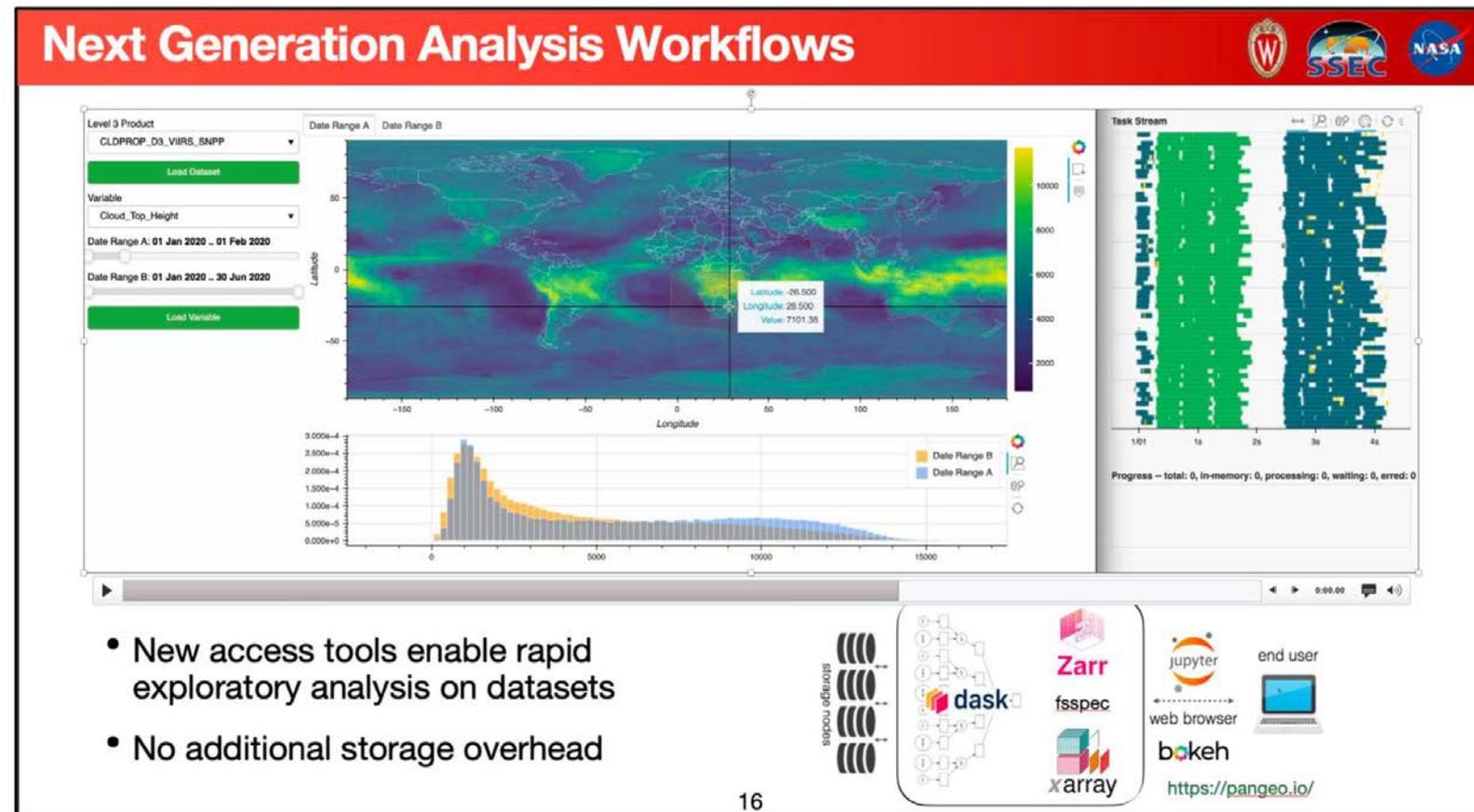
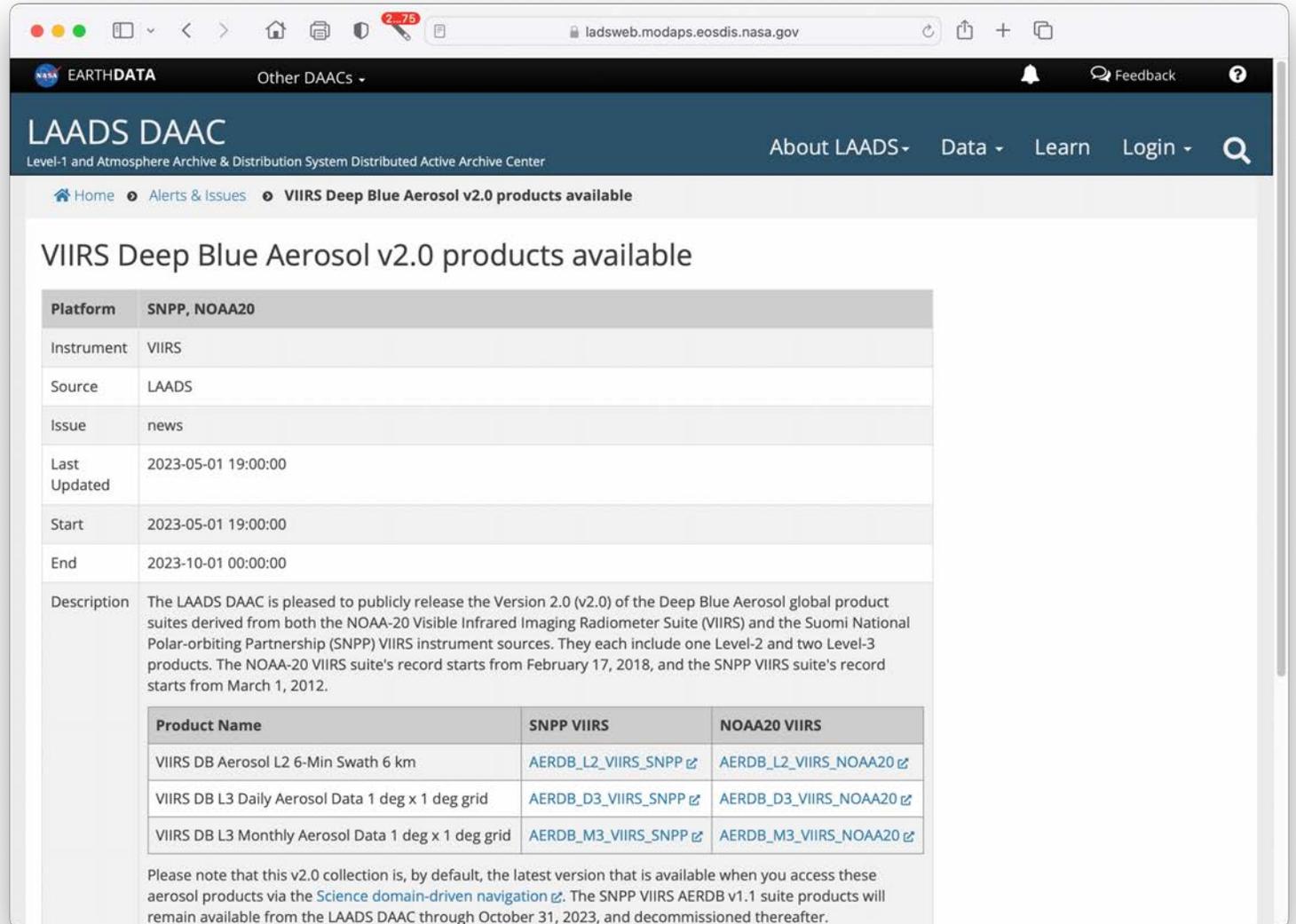


Figure 1. A-SIPS next generation of analysis workflows with new tools that enable rapid exploratory analysis of user selected data sets and variables. (Griffith, et al., 2022)

LAADS archive and distribution

- VIIRS Deep Blue L2 and L3 for SNPP and NOAA-20 (v2.0 was just released)
- VIIRS Dark Target L2 for SNPP and NOAA-20 (v2.0 has been delivered to LAADS; awaiting public release).
- MODIS/VIIRS Continuity Cloud Mask for SNPP and NOAA-20.
- MODIS/VIIRS Continuity Cloud Product for SNPP and NOAA-20.



The screenshot shows the LAADS DAAC website interface. The browser address bar displays 'ladswb.modaps.eosdis.nasa.gov'. The page header includes the NASA EarthData logo and navigation links for 'About LAADS', 'Data', 'Learn', and 'Login'. A breadcrumb trail indicates the current page is 'VIIRS Deep Blue Aerosol v2.0 products available'. The main content area features a title 'VIIRS Deep Blue Aerosol v2.0 products available' and a metadata table.

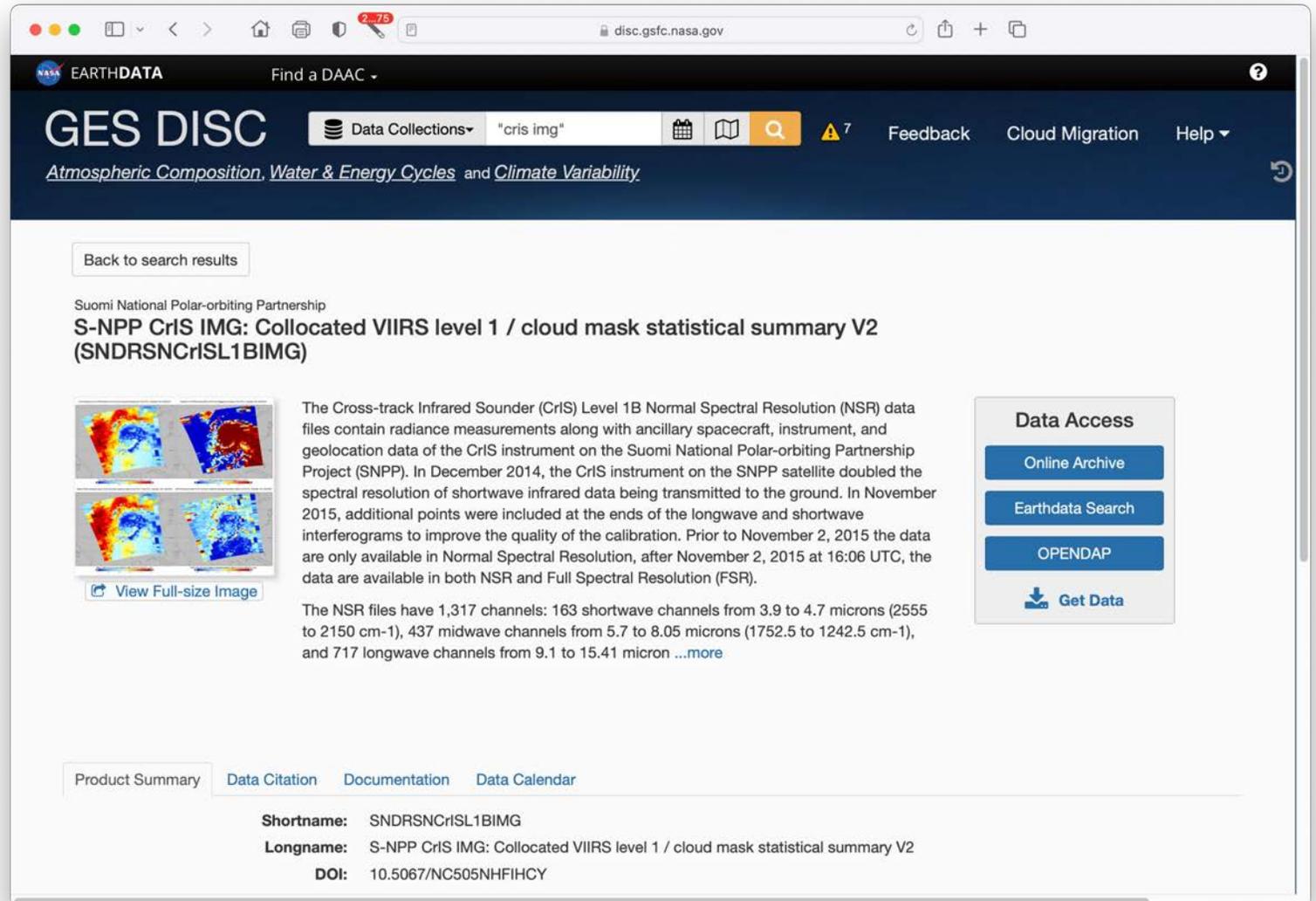
Platform	SNPP, NOAA20
Instrument	VIIRS
Source	LAADS
Issue	news
Last Updated	2023-05-01 19:00:00
Start	2023-05-01 19:00:00
End	2023-10-01 00:00:00
Description	The LAADS DAAC is pleased to publicly release the Version 2.0 (v2.0) of the Deep Blue Aerosol global product suites derived from both the NOAA-20 Visible Infrared Imaging Radiometer Suite (VIIRS) and the Suomi National Polar-orbiting Partnership (SNPP) VIIRS instrument sources. They each include one Level-2 and two Level-3 products. The NOAA-20 VIIRS suite's record starts from February 17, 2018, and the SNPP VIIRS suite's record starts from March 1, 2012.

Product Name	SNPP VIIRS	NOAA20 VIIRS
VIIRS DB Aerosol L2 6-Min Swath 6 km	AERDB_L2_VIIRS_SNPP	AERDB_L2_VIIRS_NOAA20
VIIRS DB L3 Daily Aerosol Data 1 deg x 1 deg grid	AERDB_D3_VIIRS_SNPP	AERDB_D3_VIIRS_NOAA20
VIIRS DB L3 Monthly Aerosol Data 1 deg x 1 deg grid	AERDB_M3_VIIRS_SNPP	AERDB_M3_VIIRS_NOAA20

Please note that this v2.0 collection is, by default, the latest version that is available when you access these aerosol products via the [Science domain-driven navigation](#). The SNPP VIIRS AERDB v1.1 suite products will remain available from the LAADS DAAC through October 31, 2023, and decommissioned thereafter.

GESDISC archive and distribution

- CrIS/VIIRS collocated radiance and cloud mask statistics for SNPP and NOAA-20.
- NOAA-21 version (not yet available at LAADS) has already been used to check CrIS/VIIRS TEB inter-calibration.



The screenshot shows the GES DISC website interface. The browser address bar displays 'disc.gsfc.nasa.gov'. The page header includes the NASA EarthData logo and a search bar containing 'cris img'. Below the header, the search results page is titled 'S-NPP CrIS IMG: Collocated VIIRS level 1 / cloud mask statistical summary V2 (SNDRSNCrISL1BIMG)'. The page features a 'Data Access' sidebar with buttons for 'Online Archive', 'Earthdata Search', 'OPENDAP', and 'Get Data'. The main content area includes a 'Back to search results' button, a description of the data, and a 'View Full-size Image' link. The data description states: 'The Cross-track Infrared Sounder (CrIS) Level 1B Normal Spectral Resolution (NSR) data files contain radiance measurements along with ancillary spacecraft, instrument, and geolocation data of the CrIS instrument on the Suomi National Polar-orbiting Partnership Project (SNPP). In December 2014, the CrIS instrument on the SNPP satellite doubled the spectral resolution of shortwave infrared data being transmitted to the ground. In November 2015, additional points were included at the ends of the longwave and shortwave interferograms to improve the quality of the calibration. Prior to November 2, 2015 the data are only available in Normal Spectral Resolution, after November 2, 2015 at 16:06 UTC, the data are available in both NSR and Full Spectral Resolution (FSR). The NSR files have 1,317 channels: 163 shortwave channels from 3.9 to 4.7 microns (2555 to 2150 cm⁻¹), 437 midwave channels from 5.7 to 8.05 microns (1752.5 to 1242.5 cm⁻¹), and 717 longwave channels from 9.1 to 15.41 micron ...more'. At the bottom, there are navigation tabs for 'Product Summary', 'Data Citation', 'Documentation', and 'Data Calendar', followed by metadata fields: 'Shortname: SNDRSNCrISL1BIMG', 'Longname: S-NPP CrIS IMG: Collocated VIIRS level 1 / cloud mask statistical summary V2', and 'DOI: 10.5067/NC505NHFIHCY'.

CMR command-line search & download utility

[gumley@bolt cmrfetch_linux_amd64]\$./cmrfetch collections -s "cldmsk*" Find collections containing "cldmsk"

SHORTNAME	VERSION	CONCEPT	REVISION_ID	PROVIDER
CLDMSK_L2_MODIS_Aqua	1	C1593392869-LAADS	9	LAADS
CLDMSK_L2_VIIRS_NOAA20_NRT	1	C2003160566-ASIPS	3	ASIPS
CLDMSK_L2_VIIRS_NOAA20	1	C1964798938-LAADS	6	LAADS
CLDMSK_L2_VIIRS_SNPP_NRT	1	C1607563719-ASIPS	3	ASIPS
CLDMSK_L2_VIIRS_SNPP	1	C1562021084-LAADS	7	LAADS

[gumley@bolt cmrfetch_linux_amd64]\$./cmrfetch granules -c C1964798938-LAADS -t 2023-04-01,2023-04-01T00:06:00Z Find NOAA-20 cloud mask for date/time

NAME	SIZE	NATIVE_ID	CONCEPT_ID	REVISION_ID
CLDMSK_L2_VIIRS_NOAA20.A2023091.0006.001.2023091131339.nc	52.2 MB	LAADS:7485481337	G2647214816-LAADS	1
CLDMSK_L2_VIIRS_NOAA20.A2023091.0000.001.2023091131336.nc	43.3 MB	LAADS:7485481318	G2647214807-LAADS	1
CLDMSK_L2_VIIRS_NOAA20.A2023090.2354.001.2023091121321.nc	50.2 MB	LAADS:7485462762	G2647210867-LAADS	1

[gumley@bolt cmrfetch_linux_amd64]\$./cmrfetch granules -c C1964798938-LAADS -t 2023-04-01,2023-04-01T00:06:00Z --download ./downloads Download cloud mask granules

2023/05/02 21:03:55 fetched https://ladsweb.modaps.eosdis.nasa.gov/archive/allData/5110/CLDMSK_L2_VIIRS_NOAA20/2023/091/CLDMSK_L2_VIIRS_NOAA20.A2023091.0000.001.2023091131336.nc in 8.1s(40.9 Mb/s)
 2023/05/02 21:03:56 fetched https://ladsweb.modaps.eosdis.nasa.gov/archive/allData/5110/CLDMSK_L2_VIIRS_NOAA20/2023/091/CLDMSK_L2_VIIRS_NOAA20.A2023091.0006.001.2023091131339.nc in 9.2s(43.1 Mb/s)
 2023/05/02 21:03:56 fetched https://ladsweb.modaps.eosdis.nasa.gov/archive/allData/5110/CLDMSK_L2_VIIRS_NOAA20/2023/090/CLDMSK_L2_VIIRS_NOAA20.A2023090.2354.001.2023091121321.nc in 9.4s(40.9 Mb/s)

[gumley@bolt cmrfetch_linux_amd64]\$./cmrfetch granules -c C1964798938-LAADS -f CLDMSK_L2_VIIRS_NOAA20.A2023091.0006.001.2023091131339.nc -o long Show granule metadata

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checksum_alg	MD5
download_url	https://ladsweb.modaps.eosdis.nasa.gov/archive/allData/5110/CLDMSK_L2_VIIRS_NOAA20/2023/091/CLDMSK_L2_VIIRS_NOAA20.A2023091.0006.001.2023091131339.nc
native_id	LAADS:7485481337
revision_id	1
concept_id	G2647214816-LAADS
collection	CLDMSK_L2_VIIRS_NOAA20/1
download_direct_url	s3://prod-lads/CLDMSK_L2_VIIRS_NOAA20/CLDMSK_L2_VIIRS_NOAA20.A2023091.0006.001.2023091131339.nc
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timerange	[2023-04-01T00:06:00.000Z 2023-04-01T00:12:00.000Z]
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End

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